

Development Sprawl Impacts on the Terrestrial Carbon Dynamics of the United States

Principal Investigator:

**Christopher D. Elvidge
Office of the Director
NOAA National Geophysical Data Center
325 Broadway
Boulder, Colorado 80303 USA
Telephone: 303-497-6121 Fax: 303-497-6513
E-mail: cde@ngdc.noaa.gov**

Co-Investigators:

**Ramakrishna Nemani, School of Forestry, University of Montana,
Missoula, MT 59812 Tel. 406-243-6311 Fax: 406-243-4510
e-mail: nemani@ntsg.umt.edu**

**James E. Vogelmann, Raytheon ITSS Corporation, USGS EROS Data Center
Sioux Falls, SD 57103 Tel. 605-594-6062
Email: vogel@edcmail.cr.usgs.gov**

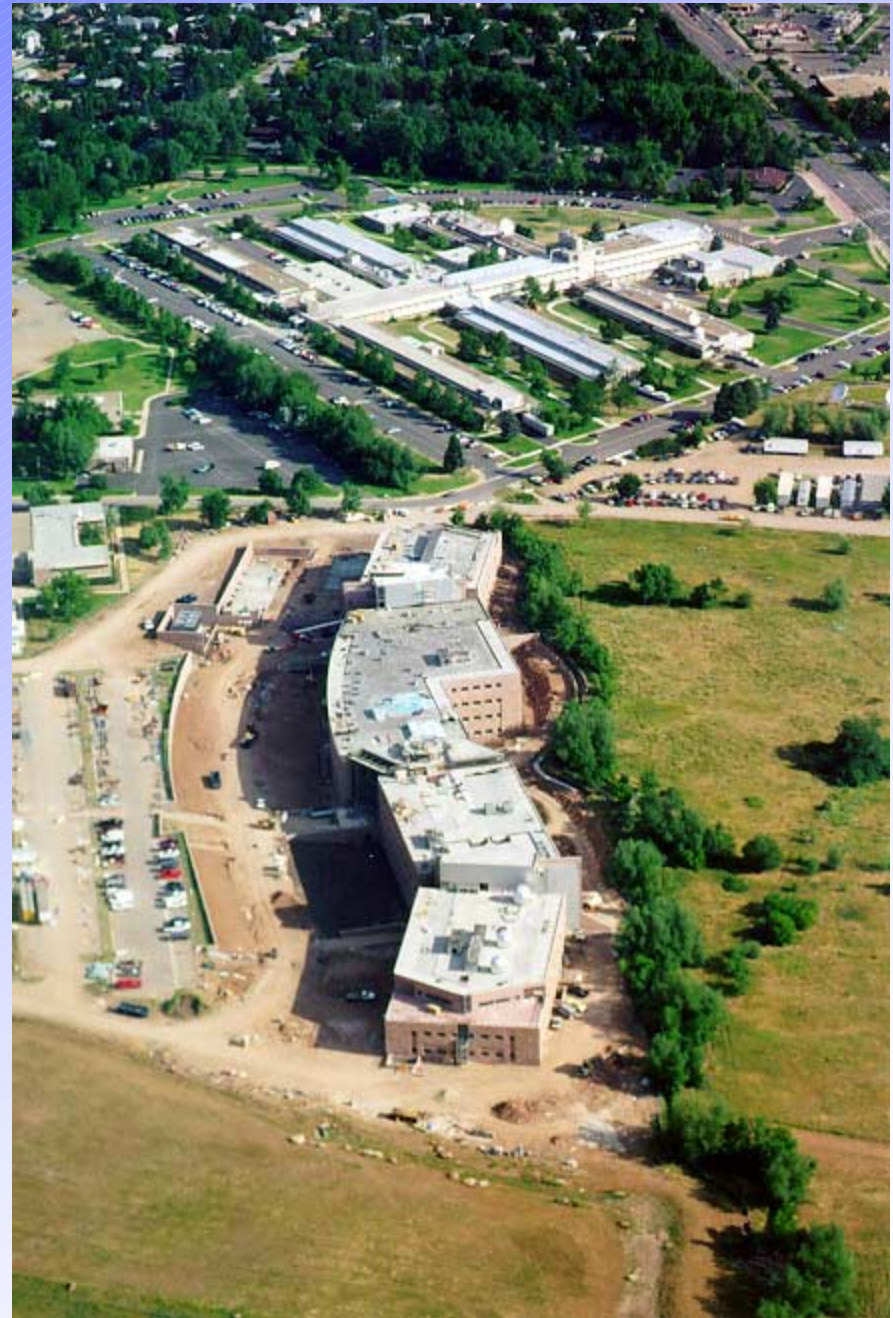
Objective of the Study

To analyze the impacts of development on the terrestrial carbon dynamics of the 48 states. The impact will be analyzed by comparing ecosystem model runs made using land cover data with and without the current level of development



Science Implications

Surfaces covered by constructed materials (roads, buildings, etc.) are withdrawn from photosynthesis and respiration. This loss is counterbalanced to some extent by managed vegetation (lawns, trees, etc.), which may be irrigated and fertilized. Unlike other types of disturbances, development typically does not have a recovery phase. Other disturbances such as deforestation have a demonstrable effect on terrestrial carbon dynamics. We will evaluate the impact development has on terrestrial carbon dynamics, and how this effect varies spatially. This information should be useful for improving our understanding, modeling and prediction of the global carbon cycle and the build up of carbon dioxide in the atmosphere.



Heritage of the Research

NOAA-NGDC has been developing algorithms for mapping and measuring development patterns worldwide based on low light imaging data from the Defense Meteorological Satellite Program (DMSP) Operational Linescan System (OLS) since 1994. Recent advances include the implementation of an atmospheric correction and improvements in OLS cloud detection.

The University of Montana Regional Hydro-Ecological Simulation System (RHESSys) use the BIOME - BGC ecosystem model to compute carbon exchange processes at various spatio-temporal scales. BIOME-BGC HAS BEEN extensively used to study various aspects of the carbon cycle over the continental U.S.

The USGS and EPA have been working in collaboration to develop a 30-m resolution land cover data set for the conterminous United States using 1991-93 vintage Landsat Thematic Mapper (TM) data acquired by the Multiresolution Land Characteristics (MRLC) consortium. The project is close to completion, with the first TM-derived national-scale land cover product anticipated by the end of September, 2000.

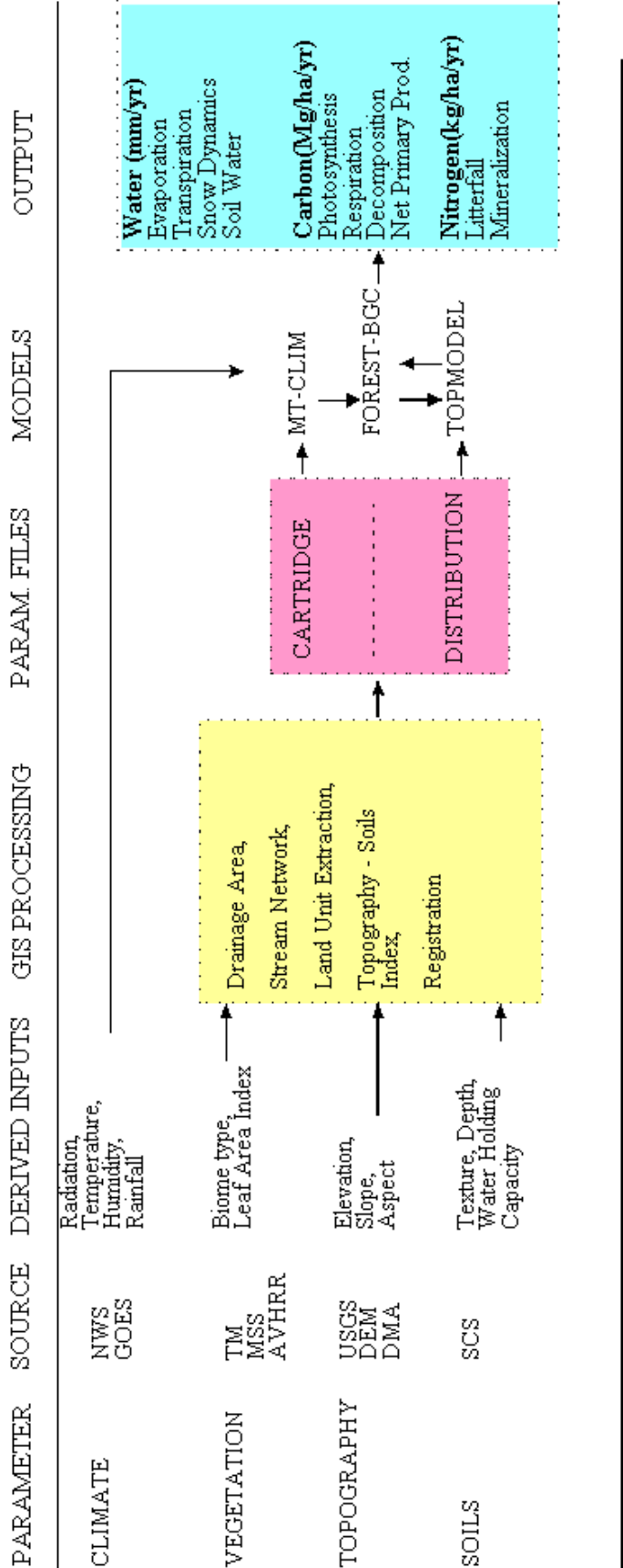
Methods

We will make use of multiple sources of data to generate a one km landcover grid of the USA with specific estimates of the percent cover of constructed materials, lawn and trees/shrubs within developed areas. The national 1 km data sets we plan to use include: 1) regrided 30 meter land cover from Landsat TM (MRLC), 2) radiance calibrated nighttime lights from the DMSP-OLS, 3) road density U.S. Census Bureau (TIGER data).

For calibration, development, lawn and tree cover will be measured directly in a subsample of the area using aerial photography (1998-00) acquired along transects crossing major metropolitan areas in each region of the country.

We will use the RHESSys ecosystem model to analyze the carbon dynamics of the US with and without the current level of development.

REGIONAL HYDRO-ECOLOGICAL SIMULATION SYSTEM (RHESSys)



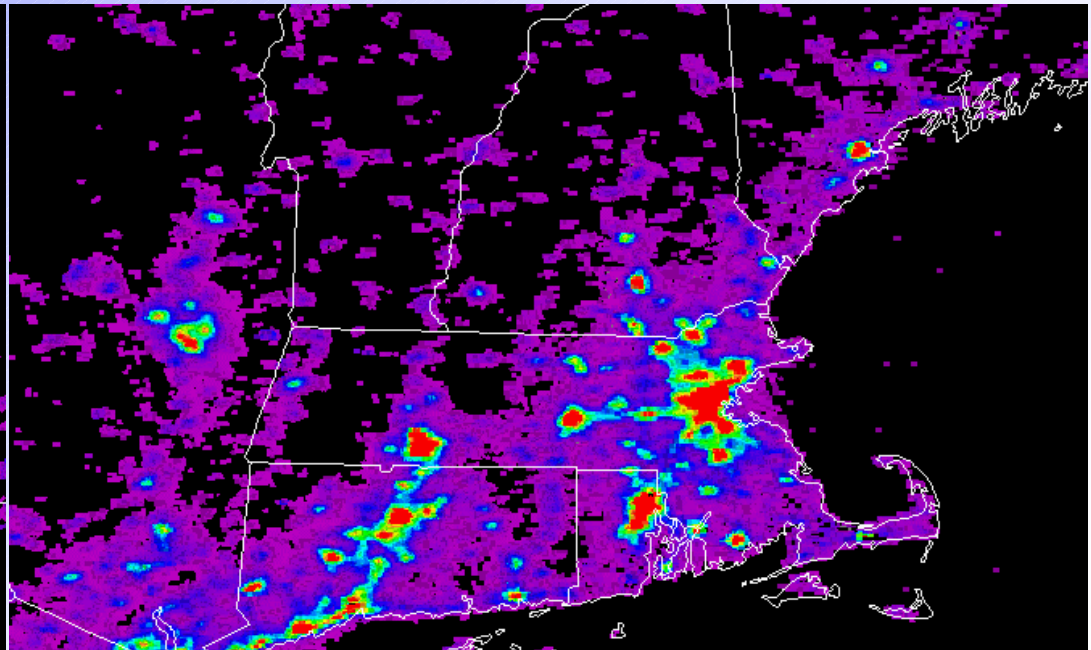
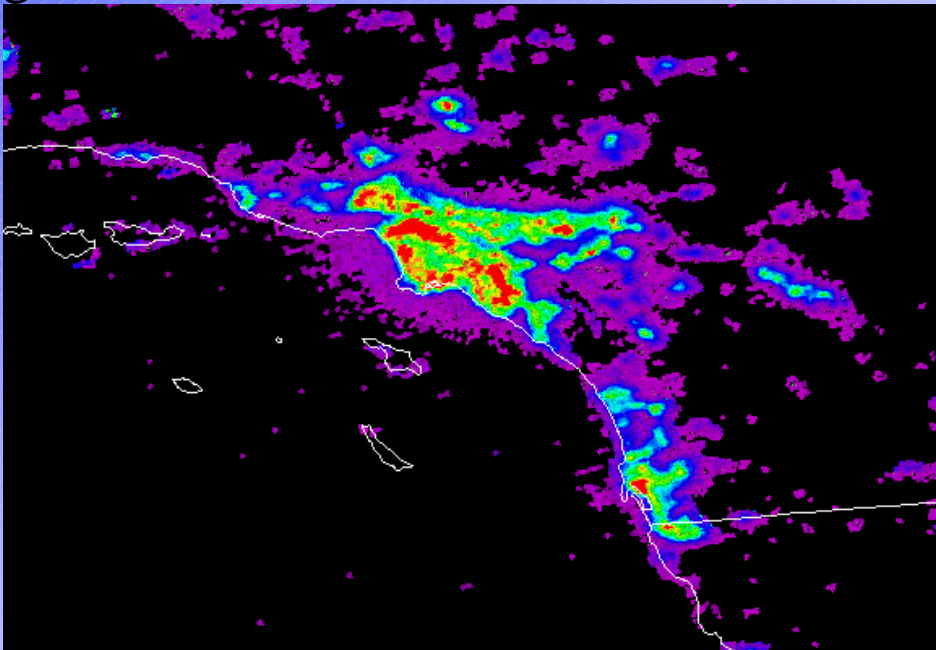
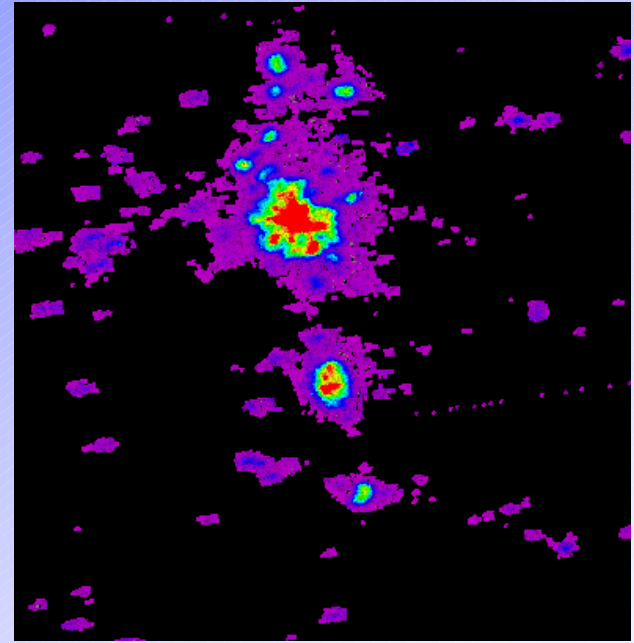
NWS- National Weather Service
GOES- Geostationary Operational Environ. Satellite
TM- Landsat / Thematic Mapper
MSS- Landsat / Multispectral Scanner
AVHRR- NOAA / Advanced Very High Resolution Radiometer
USGS- United States Geological Survey
DEM- Digital Elevation Model
DMA-
SCS- Defense Mapping Agency
Soil Conservation Survey

CARTRIDGE- Land unit parameterization
DISTRIBUTION- Within Land unit parameterization
MT-CLIM- Mountain Microclimate Simulator
FOREST-BGC- Forest Ecosystem Simulator
TOPMODEL- Hydrologic Routing Simulator

Data Plan

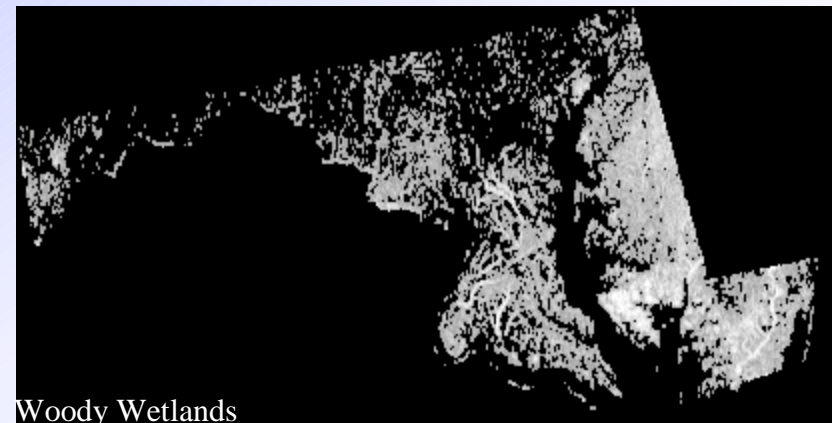
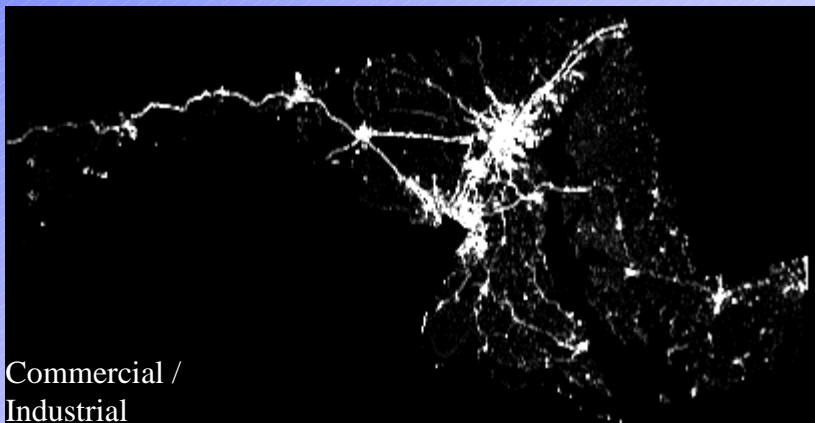
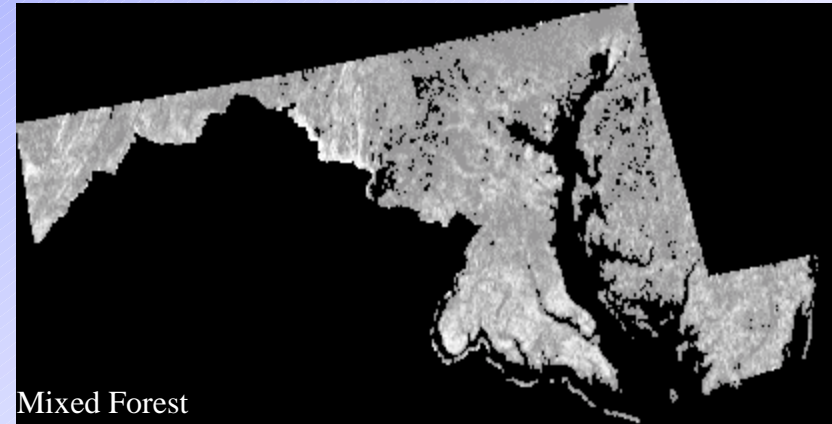
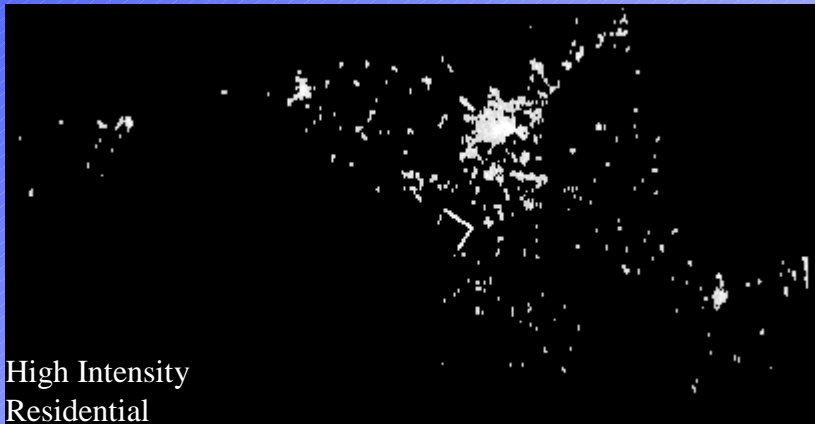
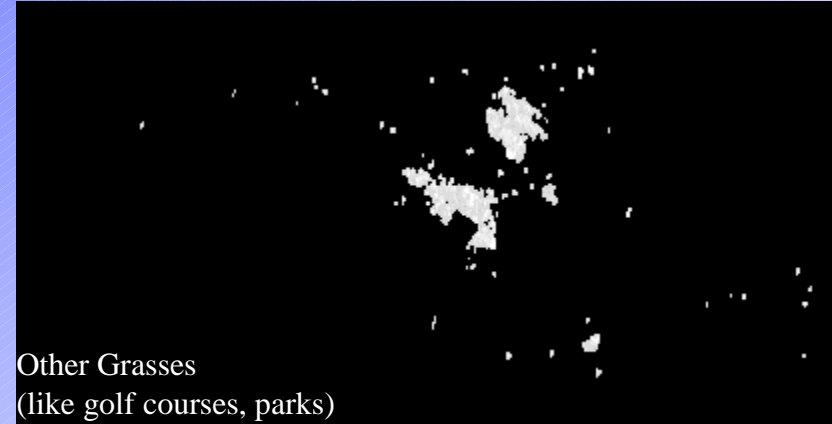
We have prototyped the following data types for the project:

1. NGDC has produced a prototype of the radiance calibrated nighttime lights of the USA which will be used for the project using nighttime OLS data acquired at reduced gain settings in November-December, 1999 and January, February, and March of 2000. This is our first product made using an atmospheric correction to retrieve estimates of surface radiances and an improved method for OLS cloud detection based on NCEP surface temperature grids.



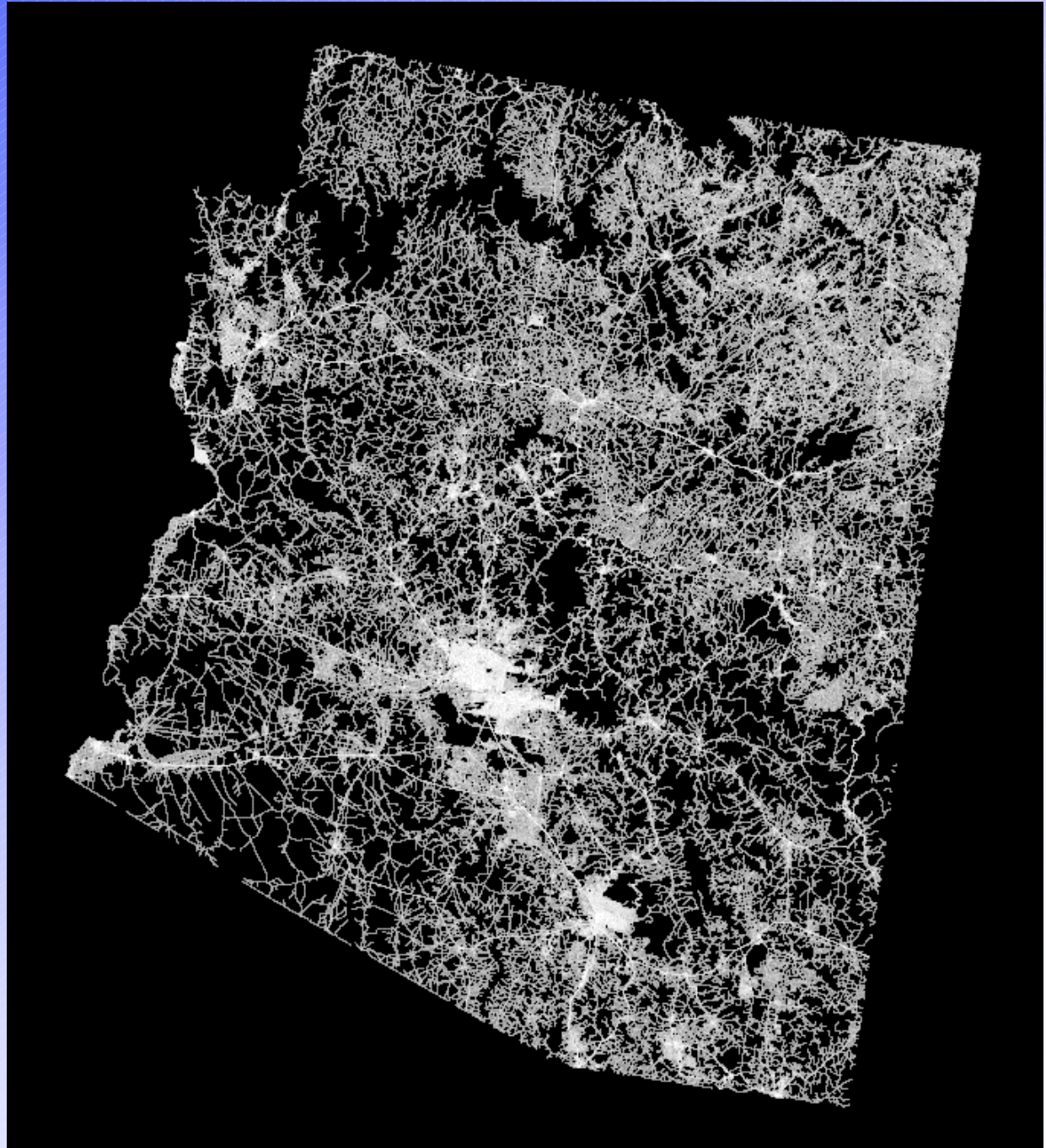
Data Plan (continued)

2. USGS-EDC has produced 1 km grids of the MRLC land cover data for 35 states.



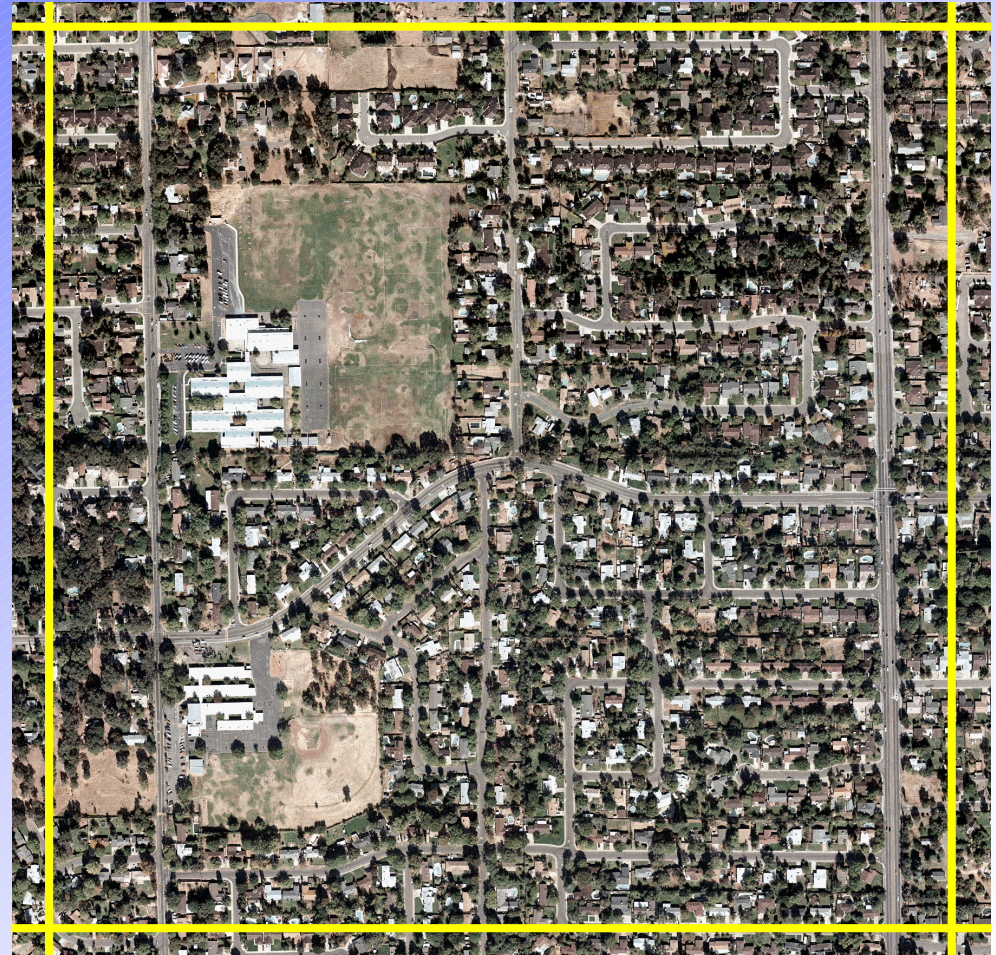
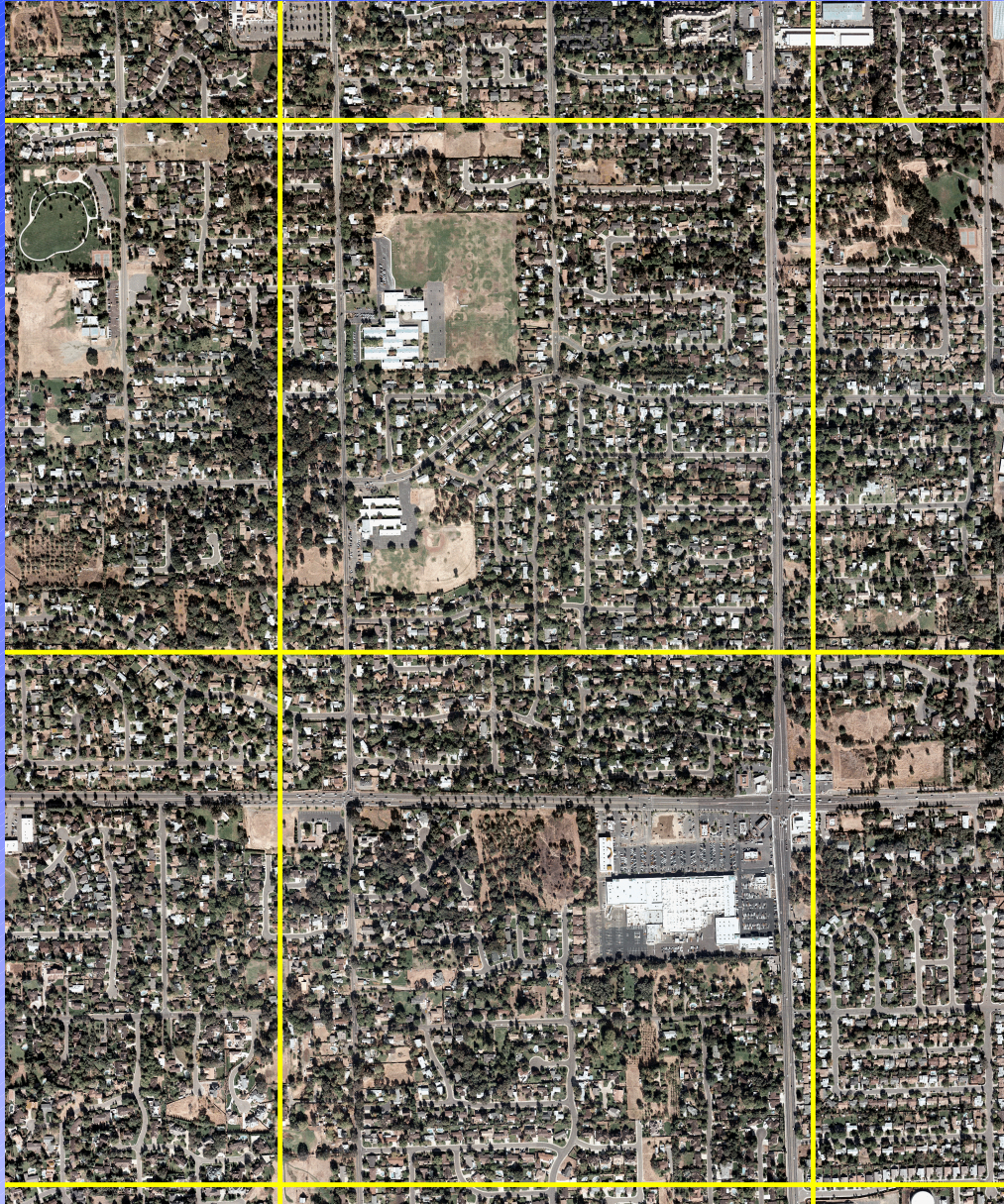
Data Plan (continued)

3. NGDC has produced a 1 km grid depicting the length of roads present in U.S. Census Bureau TIGER data for a single state.



Data Plan (continued)

4. NGDC has developed methods to extract 1 km² tiles from commercially available color orthophotos.



Work Schedule

Year One: Production of source 1 km grids for nighttime lights, road density, and MRLC land cover. Testing and improvement of RHESSys for use in the project.

Year Two: Production of 1 km grids for coverage of constructed materials, lawns, and trees in developed areas. This will be reconciled and merged with the 1 km MRLC land cover. RHESSys runs made with resulting land cover product.

Year Three: Production of a simulated 1 km land cover with development areas removed. RHESSys runs made with resulting land cover product. Project results will be written for peer review publication.